

# ASTRONOMERS MAKING ACCURATE MAPS OF MOON BEFORE ENTIRE EARTH HAS BEEN SURVEYED FULLY

## Men Who "Live in Stars" Watch for First Flash of Light That Started Toward This Planet 30,000 Years Ago to Disclose Undiscovered World

### PHOTOGRAPHS OF MARS MAY PROVE EXISTENCE OF LIFE DESPITE CLAIMS OF SCOFFERS

#### Dr. Walter Matos Sits Under Huge Telescope at Swarthmore Observatory and Urges Rank and File to Take Up His Favorite Study

**D**ID YOU ever spend most of a night in a great astronomical observatory and take up star-gazing in a serious way—for just once, at least?

Probably not. The registers of even casual visitors at most of the more important observatories indicate that not one person in a hundred thousand has ever been inside of an observatory, to say nothing of spending a night in one. It is an event to have your eye greeted for the first time by light which has filtered down through a giant telescope after traveling two centuries at the rate of 186,000 miles a second from a star 1,173,139,200,000,000 miles away.

Have you ever stopped to consider that the very nearest of the stars—and don't confuse stars, which are suns, with the planets of our own solar system—are about 4.3-10 light years distant?

Young folk in canoes, in hammocks and on beaches and front porches during these summer months, who look at the heavens while murmuring soft nothings to each other, are not likely to ponder much on these things, but after they are safely married—

Does vegetation or life of any kind exist on Mars or the moon? What makes you think so?

Do you know that astronomers get the time at night from the stars without the slightest difficulty to within a fiftieth part of a second, as a matter of course, and that they probably could get it down to one-hundredth part of a second were it of practical benefit to do so?

There are probably between four and five thousand catalogued stars visible to the naked eye in the latitude of Philadelphia. Did you know that there was a telescopic adjustment formula for the finding of each of these stars, and many others not visible to the naked eye, by setting the instrument even before the observer looks into it?

That when it is adjusted and you peer through the eye piece, there lies your star in the field before the eye, winking at you pleasantly with purest ray serene and defying you to read its riddle?

There are so many questions like these to puzzle or startle the uninitiated. But the professional astronomer would only smile at them—they know so many more!

The whole universe, come to think of it, is a great question mark.

### Astronomy, Like Golf, an Engrossing Pursuit

Astronomy is a good deal like golf. If it ever gets its hooks into one's tender susceptibilities he is done for; and then the older he gets the greater addict he becomes. It is a sort of religion among sciences, just as golf is among sports.

Out at Swarthmore College they are trying to "sell" astronomy as an amateur side line to the adjacent community, and to popularize it over the heads of the students who take the course from choice or necessity. This the faculty is glad to do, so that the greatest benefits may be derived from the Sproul Observatory, splendid gift of an alumnus of 1891, who is now the Governor of Pennsylvania.

The Sproul Observatory is one of the most completely equipped of the country. Its wonderful refracting telescope has a twenty-four-inch lens that alone cost \$14,000. It is the sixth largest refracting telescope in the world. This telescope is flanked by a half dozen smaller ones, two of good size and a smaller in the students' observatory.

There are, in addition, photographic facilities for taking exposures of stars and comets, darkrooms for developing the precious plates, a wonderful astronomical library filled with histories, romances, facts and fancies and statistics of the heavens, and there are workrooms, classrooms and computation rooms. In the latter are marvelous calculating engines, super-human wizards of figures, that will multiply or divide great strings of figures with unflinching precision in the flick of an eyelid, thereby eliminating great mental drudgery.

### Light of Some Stars Centuries Reaching Earth

Also there are many thousands of photographic plates, that have been exposed to rays from stars so remote that their distance can be calculated only in light years, and a light year, as any schoolboy knows in these days of youthfulness, is only the distance that light travels 186,000 miles per second.

These plates, clamped at the base, or lower end, of a telescope, and exposed from ten minutes to several hours, make of the entire telescope a giant that would be satisfied if their rays were absorbed at full strength. A revolving disc shutter, electrically operated at the base of the telescope, can be adjusted, if necessary, to permit the penetration of only a hundredth or a thousandth part of the straight that comes through the big camera barrel.

Flammurion says that spirits go to

other worlds after death. They tell a story at Swarthmore:

Four years ago a beautiful child in the neighborhood, a little girl of seven, was known for her fondness for the morning star, and she would awake at half-past 3 or 4 o'clock in the morning, go to her bedroom window and look long and intently at it. She called it her "very own star" and she never ceased marveling at its brilliancy. Some one told her about the Sproul Observatory and took her there to see the great telescope, which excited her childish imagination to the highest pitch. The observer showed her a few stars through the great tube, but she was not content. She wanted to see her "own star." That meant she would have to cultivate the morning observer, on duty from 1 o'clock to daylight. Her parents could not arrange to take her in these unearthly hours, so the matter lapsed.

### Child Makes Midnight Trip to See "Her Star"

But one morning the observer up under the big dome, seated on his giant "cannon," or great rolling stepladder, heard a noise. Switching on the lights he saw a demure little figure in night-dress, slippers and shawl, peering cagily at him. She had walked two miles in the dark over the lonely roads to see "her morning star."

The observer adjusted the telescope, lifted the little miss up on the chair, and was rewarded by her rapture. He allowed her to remain and glory in her star until she began to tremble with chill. Wrapping his coat about her, he carried her home.

A few days later she was taken ill and died. She repeatedly told her mother before the end: "Mamma, I am going away—I am going to my star."

And who knows? According to Flammurion and others—perhaps she did.

Spending a night in that observatory alone, save for the observer, with the splendor of the blue-black vault above, is a moving and inspiring experience.

The Rev. Walter A. Matos, fellow of the Royal Astronomical Society of Great Britain and for many years prior to the erection of the Sproul telescope, thirteen years ago, an observer at the Philadelphia Observatory, was visited one evening recently. There seems something entirely fitting in the idea of a sky pilot being a practical astronomer, and, questioned on this point, Mr. Matos said with a smile that more than 100 of the 800 members of the Royal Astronomical Society are clergymen.

Mr. Matos explained that the principal astronomical work done at Swarthmore is that of taking the parallaxes. In plain language this means measuring their distance from the earth by means of comparative angles from other stars on which the usual astronomical computations of higher mathematics can be based. It was the development of astronomy that resulted in the absolute necessity for higher mathematics.

### Astronomy Is Foundation of Modern Science

Mr. Matos pointed out that all trade and commerce now depend upon astronomy, and mentioned, in indicating its usefulness, that navigation is absolutely dependent upon it.

These are some of the truths that must be drummed into the head of the tyro so that he can understand how fundamental is the study of the stars and their measurements and order in the universe.

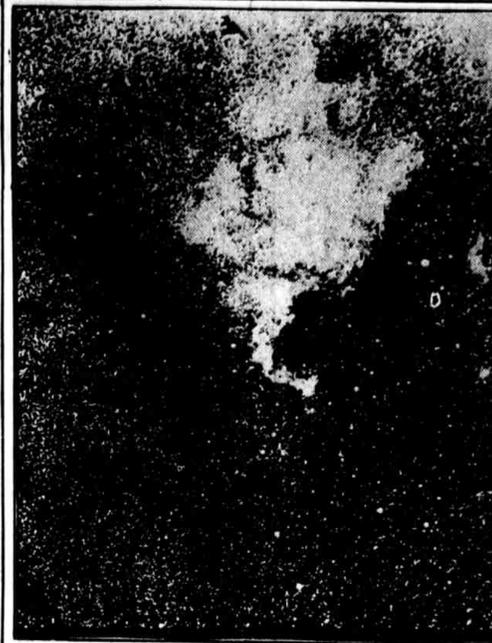
While Mr. Matos was arranging the set-up of the telescope, which has as many complicated parts and devices as the interior of a submarine, he was caught unawares.

"Thinking it by no means large, what is the objective of science?" was a question tossed off carelessly.

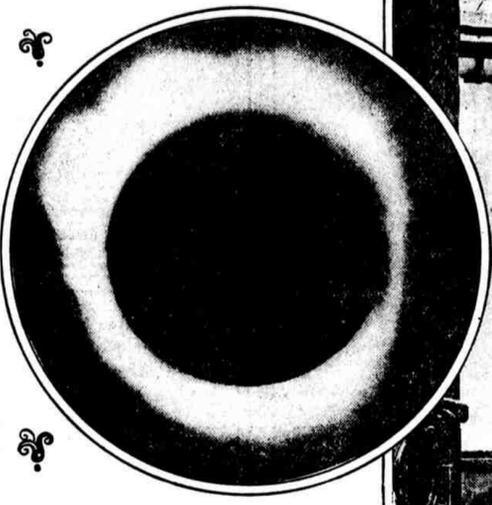
"The goal of all science," came the reply, "is the capacity for prediction. To anticipate the future is the most important object of all human energy and intelligence, and nothing can be done in that direction without science. So far as science approaches that goal it approaches perfection, and astronomy is essentially a science of prediction. It can predict an eclipse a thousand years in advance. It can calculate the exact moment of the turn of the tide twice each day for a century. It can determine the position of the moon at any hour of any night for generations yet to come."

"It wasn't so long ago that the world was frightened at the appearance of a comet. Astronomy has shown that the universe is full of comets and that they are as harmless as they are beautiful. There need be no apprehension on account of their appearance."

Mr. Matos started the hot-horse power motor that moves the great tele-



North America Nebula



Total eclipse of sun, 1918



Face of Mars, October 6, 1921

scope, which is thirty-six feet in length and weighs many tons. So perfect is its balance, however, that it can be moved about by hand with ease when it is in a convenient position. Suddenly, nearly fifty feet above, began to slide open at another larger motor started to drone. The telescope was soon pointing upward through the big slot at the heavens. It happened to be a bad night for observation, as the visibility was only about two out of a possible five.

Busily engaged in orienting the telescope with valves and levers and gauges and the greatest precision—but by looking through the instrument, but by consulting rows of figures on a sheet of paper—Mr. Matos made ready for operations. His program for the night's observations waiting for him in the observatory—there is nothing but or miss about the work—showed Tu Bootis, Argelander 1014 and 142 Corone as some of his stars.

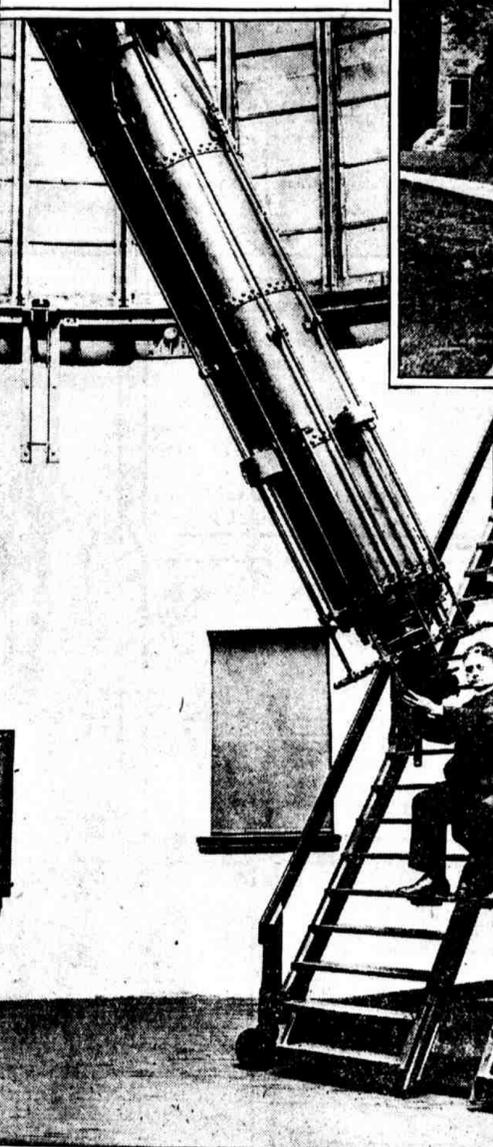
### Telescope Put in Place by Higher Mathematics

Beneath the name of each star was an array of figures to govern the adjustment. The telescope was brought to a certain tilt by one figure, then clamped to stay there; another number adjusted another position, followed by clamping, and still other preparatory movements having been made, the lights were switched off and a photographic plate was placed in position.

All being in readiness, the observer asked that the visitor climb up on the chair, or rolling stepladder of iron-diamond proportions, sit down in the adjustable seat and peer into the small eye-piece looking at right angles to the axis of the telescope.



The moon



Dr. Walter Matos at his telescope

the naked eye Canopus is enormous in size, and it looks on a bright tropical night like some great flaming lantern in the sky. The ancients used to think Canopus must be comparatively near the earth, because it appeared so large.

"Seventy years before Columbus discovered America," said Mr. Matos, "the light that now streams from Canopus over the path of the southern seas traversed by the caravels of the explorer started on its way toward the earth."

### One Star Exceeds Our Solar System in Size

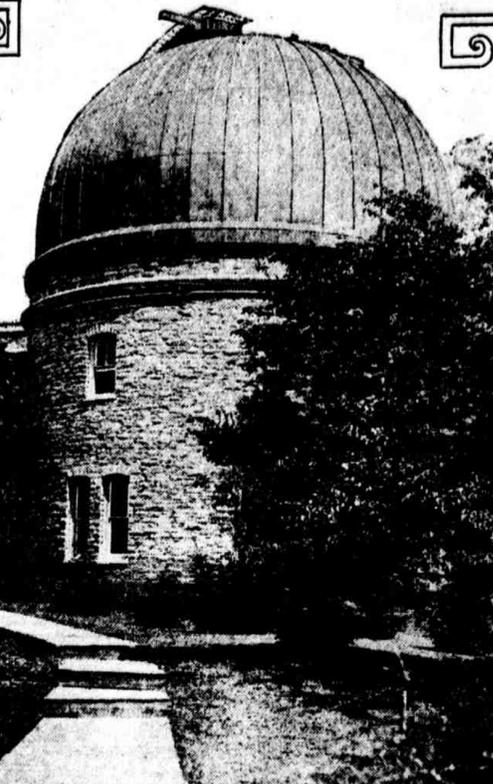
"Despite its incomprehensibly enormous size, Canopus has virtually no parallax—the angle is virtually zero. And yet that great flaming sun, gigantic beyond our understanding, is so vast in its extent that one jocular chap wrote that it could swallow our entire solar system and never notice us—and that would be quite a mouthful, too."

After one plate had been exposed for about fifteen minutes Mr. Matos found photography would have to be discontinued for that night, because of the haziness of the sky. On a night of high visibility, when the atmosphere conditions are just right and everything depends upon the state of the fifty-mile belt of atmosphere above the earth, from two to seven photographs are obtained at a string at Swarthmore.

After the plates are developed and the stars are identified with marks they are clamped upon measuring engines for the measuring of the star images shown on the plates. These measuring engines are so exact that they will measure up to one-millionth of an inch.

"The astronomical day is followed at the observatory. In other words, the change of date does not come for the astronomer at midnight, but twelve hours later, at noon, when the sun is at meridian. This is to be changed to conform with popular custom to January 1, 1925, to obviate confusion. After that date, by common consent of all the astronomical societies of the world, the nautical almanacs will change at midnight."

Mr. Matos, after many years of work with it, holds a genuine affection for the Sproul telescope. Its size he



Sproul Observatory, Swarthmore College

light coming from them now, I showed him, had started about 24,000 years before the dawn of history in Egypt, so after all we were rather slow.

"The man was vexed with me," Suresly, he said, "you don't believe in that kind of nonsense, do you?"

In the year that the Sproul Observatory was opened Flammurion suggested that there might yet be found to exist another planet beyond Neptune, outside the known limits of the solar system. Flammurion at that time had an idea that the wanderer was hundreds of millions of miles away and that its distance from the sun and the time of its revolution could one day be stated with certainty.

"It has never been found," said Mr. Matos, "but who can tell? It may be yet, some day."

### Is Mars Inhabited? Fiercely Debated Question

The world is now again excited over possible communication with Mars and filled with speculations as to whether it is inhabited. To date, to sum up the entire matter in a word, it is a matter of belief. There are as strong and even stronger arguments against the theory that it is inhabited as there are that it is peopled.

At Swarthmore the astronomers are non-committal. Flammurion has been observing Mars for the last twenty-eight years. He believes he has demonstrated that there is some intelligent form of life there, but it is impossible to explain, he says, the changes that have been taking place upon any other hypothesis.

The difficulty about even comparatively nearby Mars, only a short stone's throw in the known universe, which is nearest to us, is 37,000,000 miles distant, is in penetrating the atmosphere about the earth to bridge this distance with even the best of telescopes and cameras. Even if one had a telescope to bring the planet within 17,500 miles, for instance, the difficulty in the way of the observer still would be immense.

With Mars near us this year and with even more favorable conditions ahead for next year, especially in the Southern Hemisphere, much has been heard and will continue to be heard from that school of astronomy which believes in the habitability of the planet.

It is regarded as safe to say by the conservators among whom are those at Swarthmore, that we cannot at present, and probably never shall, be able to see Mars in the telescope as clearly as we do with the naked eye at 27,000 miles. It is also regarded as highly improbable that at distances of thousands of miles we can see planetary details with sufficient clearness to judge of their true character and nature.

### Astronomy Brings Belief in God Supreme Over All

"Studying what is visible of the universe, one cannot help believing. I never yet ran across an astronomer I could class as an atheist."

Mr. Matos was asked his opinion of the Einstein theories of relativity and He had looked into them, he said, but he did not wish to be drawn into a discussion.

"The great cluster of Hercules," he remarked thoughtfully, "is 36,000 light years distant from us, according to Herschel, Shapley, of Harvard. The older five by seven miles in size, and when illuminated with electric lights behind them they divulge with amazing clarity those stellar secrets and peculiarities hidden from the naked eye. Prints are never made from such plates at the observatory, but they are examined under microscopes and studied by faculty and students."

"The geography, or more properly, topography, of the moon," said Mr. Matos, as he pointed out a crater and valleys and various configurations as though they were on a relief map in a schoolroom, "is now as accurately known as is that of the earth. In fact, the earth that have not been surveyed, as for instance the interiors of Brazil and parts of Africa."

"The age-old and ever-recurring topic of the habitability and the population of other planets was brought up in the watches of the night quite as naturally as one mentions the weather. Mr. Matos was questioned as to his beliefs. "I feel," he said slowly, "that there is life in many, many places in the universe. It is one of the things that the astronomer cannot say he knows, but he does feel it. There are a great

many very important things that we cannot demonstrate in this world, but we are nevertheless quite sure of them, to the point of deep conviction.

"I never try as a explanation or as an individual, for instance, to give a reason why I believe in God. The very greatest theologians have been unable to present their reasons for belief in God. When I am asked I usually reply, 'I believe in God because I want to.'"

"There's absolutely no comeback to that," Mr. Matos smiled.

When Galileo looked at the moon through his first optic glass he thought that the dark areas on the surface were seas. But the world has gained more knowledge about planets than Galileo learned through telescopes. The amount of heat a planet receives depends upon its distance from the sun. The size and gravitational pull of a planet determine the density and constitution of its atmosphere.

### Mars at Least Twice as Cold as the Earth

Mars gets half as much heat as the earth, and it is believed to have not more than one-quarter as much atmosphere. Therefore, the temperature on Mars means the planet must be extremely cold. Moulton has found that it has a mean annual temperature of 20 degrees below zero, and that the surface of Mars radiates heat similarly. Many believe it to be even lower, on account of the rarity of the atmosphere of Mars. Lowell has endeavored to show a higher temperature.

The average temperature of the whole earth is about 59 degrees Fahrenheit. Numerous astronomers who have made a deep study of the physical conditions on Mars are therefore impatient with the popular views, which they pronounced absurd. A large number of the earth's category of world-long past their prime, and already in the grip of approaching death.

A thousand questions could be discussed after an evening at Swarthmore in the big observatory. The experience is one to stimulate thought and speculation in the mind of the layman. Swarthmore's observatory, however, is astronomical equipment and its other substitute a workshop and science factory, so to speak, where the essentials of astronomy are drilled into the heads of the students.